29 March 1963

MEMORANDUM FOR: Assistant for Plans and Development

THROUGH : Chief, Development Branch, P&DS 25X1

SUBJECT : Trip Report. Part I: US Army Pictorial Center
Part II: [redacted]
Part III:

PART I: US Army Pictorial Center

The main purpose of the visit to the USA Pictorial Center was to inspect some high-definition CCTV (Closed Circuit Television) equipment. Having been assigned to the TV Division of the Army Pictorial Center prior to joining NPIC, I feel that I received perfectly frank and unbiased comments and answers to my questions regarding the evaluation of the TV equipment we discussed.

2. No one company manufactures a complete line of video equipment. 25X1 [redacted], for example, produces a fairly complete line of CCTV equipment but uses monitors made by [redacted] and packaged with the [redacted] logotype. 25X1 25X1

3. As a general evaluation of some of the major names in television, Mr. 25X1 [redacted] Chief Engineer, TV Division, APC made the following statements:

25X1 [redacted] Good equipment, fairly complete line of components, 25X1 uses [redacted] monitors (generally considered the best in the field) 25X1 with a [redacted] logotype.

25X1 Lit. [redacted] APC has a poor opinion of this company but [redacted] may have improved the quality of their product in the past few years. 25X1

25X1 Lit [redacted] Good equipment, have been leaders in design and production of high-definition TV.

25X1 [redacted] Primarily R&D, also produces test equipment.

25X1 [redacted] Good equipment, fairly complete line of components.

25X1 [redacted] Mostly industrial TV rather than studio TV equipment, fairly new in the field, thus not much information available at APC.

25X1 Lit [redacted] Poor TV equipment.

25X1 [redacted] Few items, mostly industrial TV.

25X1 Lit [redacted] Poor TV equipment.

25X1 [redacted] Industrial TV and aircraft communication equipment. Not much information available at APC.

25X1 [redacted] Fair equipment. Mostly industrial TV.

25X1 [redacted] Good equipment.

25X1 [redacted] New company on Long Island. Little information available but apparently
25X1 [redacted] produces very good equipment.

4. The high-definition CCTV equipment I had hoped to see was inoperative due to a defective part (flyback transformer, cost $38.00 each). APC is very dissatisfied with this TV equipment and has decided not to spend any more money on it. The manufacturer, [redacted] is no longer producing this TV equipment. A copy of the instruction manual for this equipment is available in P&DS. 25X1

4. As another result of this visit I have been able to make arrangements to see, and possibly obtain copies of, evaluation reports on TV equipment that APC purchases or borrows. I was also given the numbers of one Army Regulation and one Department of Defense publication dealing with communication security and specifications for secure equipment. Copies of these publications have been requested from the Reference Branch, CSD.

Bandwidth required as a function of number of line scans.

Equation (13), page 22-7, Radio Engineering Handbook, by Keith Henney, McGraw-Hill Book Co., 5th Ed, 1959.

$$f_{max} = \frac{(w/h)\, m f k n^2}{2} \cdot \frac{(1+b_h)}{(1+b_v)}$$

where:

f_{max} = bandwidth required

w/h = aspect ratio, width/height, which is usually 4/3

m = resolution ratio = 0.925

f = frame frequency rate = 30 per second

k = utilization ratio = 0.75

n = number of lines per frame, e.g. 525 for US commercial

b_h = horizontal retrace ratio = 0.20

b_v = vertical retrace ratio = 0.08

The number 2 is involved because the square-wave ideal elements are actually transmitted as a sine wave.

Equation (13) can be rewritten as follows:

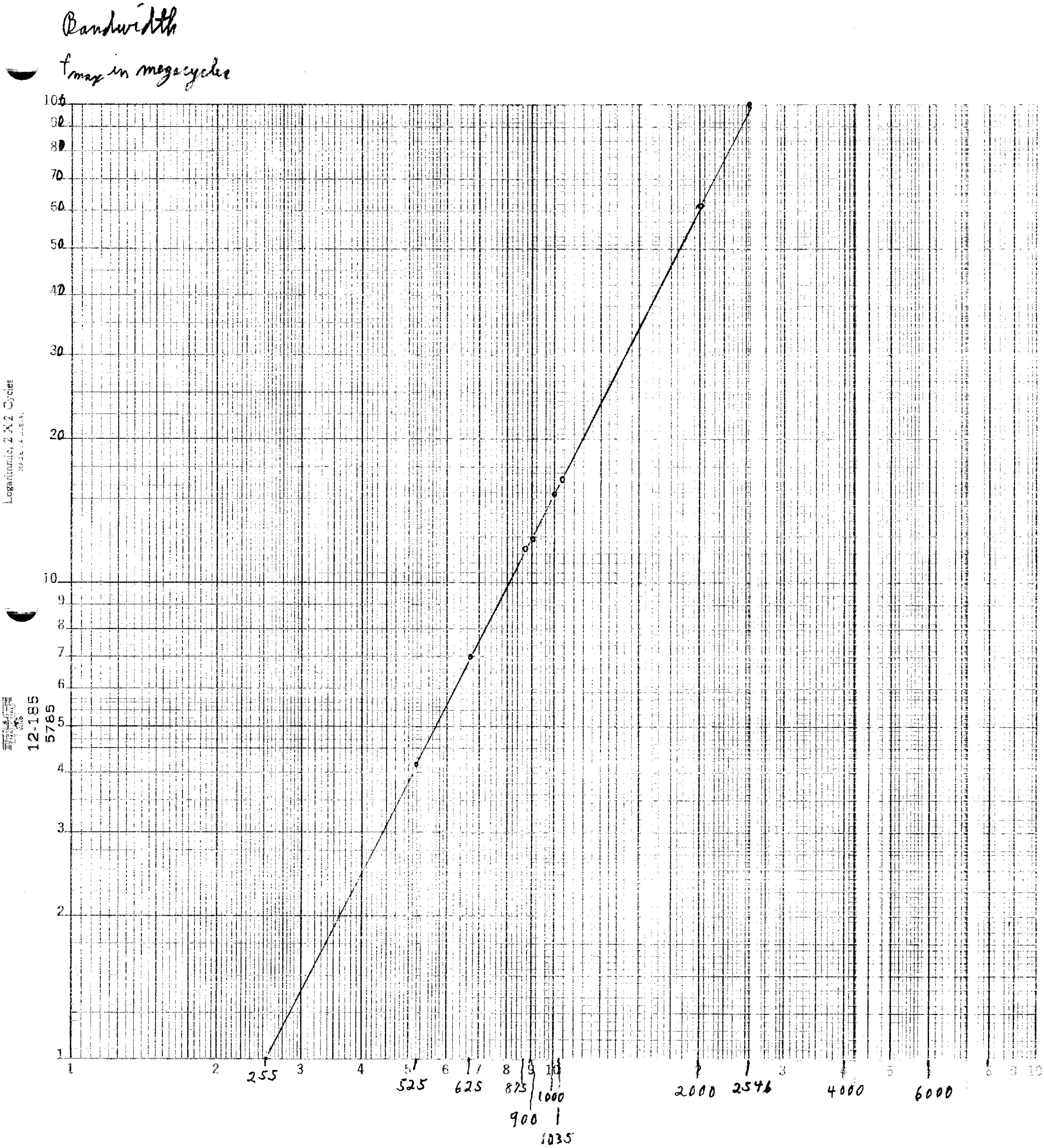
$$f_{max} = \frac{4/3 \times 0.925 \times 30 \times 0.75 \times n^2}{2} \times \frac{(1+0.20)}{(1+0.08)}$$

$f_{max} = 15.416\ n^2$ cycles/sec, or

$f_{max} = 15.416 \times 10^{-6}\ n^2$ megacycles.

$f_{max} = 15.416 \times 10^{-6} \times n^2$ megacycles

n = lines per frame	n^2	f_{max} = megacycles
255		1.000
525	275,625	4.249
675	455,625	7.024
875	765,625	11.803
900	810,000	12.487
1000	1,000,000	15.416
1035	1,071,225	16.514
2000	4,000,000	61.664
2547		100.000
4000	16,000,000	246.656
6000	36,000,000	554.976
8000	64,000,000.	986.624


Bandwidth
f_{max} in megacycles
255
525
625
875
900
1000
1035
2000
2546
4000
6000
number of scan lines
Logarithmic, 2 X 2 Cycles
12-185
5785

COPING WITH NEW PROBLEMS

Nomographs Select Tv Standards

Charts enable design engineers to get overall view of various combinations of bandwidth, resolution, scanning rates, aspect ratios and blanking interval

By J. WARREN WIPSON
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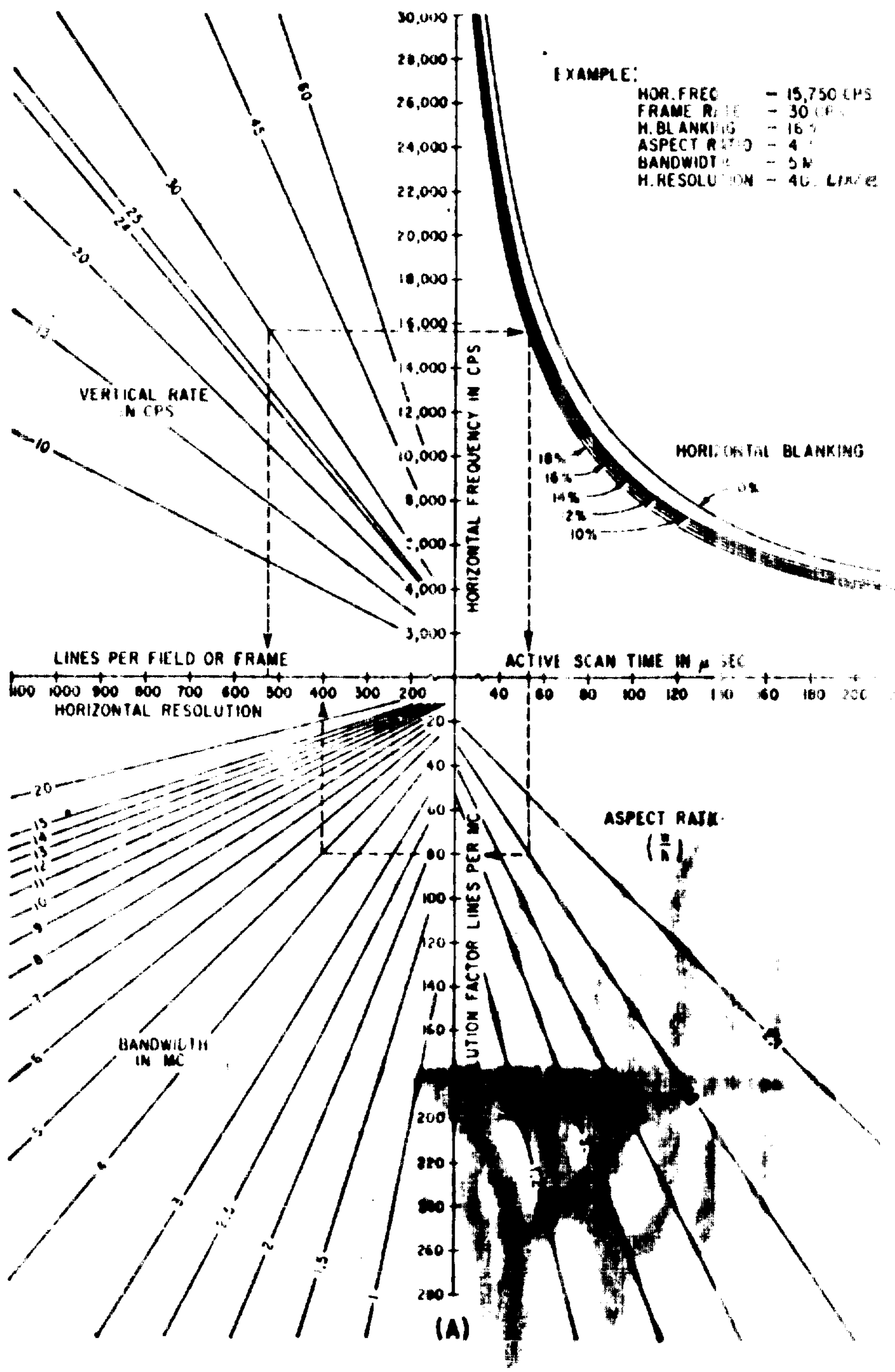
WITH the increase of military television, ground-based and space-borne, a number of television system standards have come into use. While the conventional broadcast standard is most commonly used, the gamut runs from wide bandwidth high-resolution to narrow bandwidth slow-scan space systems.[1,2] Resolution for any particular application may range from 100 or 200 tv lines to well over 1,000 lines with corresponding video bandwidths spanning from a few Kc to over 20 Mc. With this wide choice, the job of specifying and evaluating tv systems can be overwhelming. With the charts in this article, the systems engineer can obtain an overall view of various combinations of bandwidth, resolution, scanning rates, aspect ratios and horizontal blanking intervals.

FORMULA INVOLVED—The nomographs were developed from



(A)

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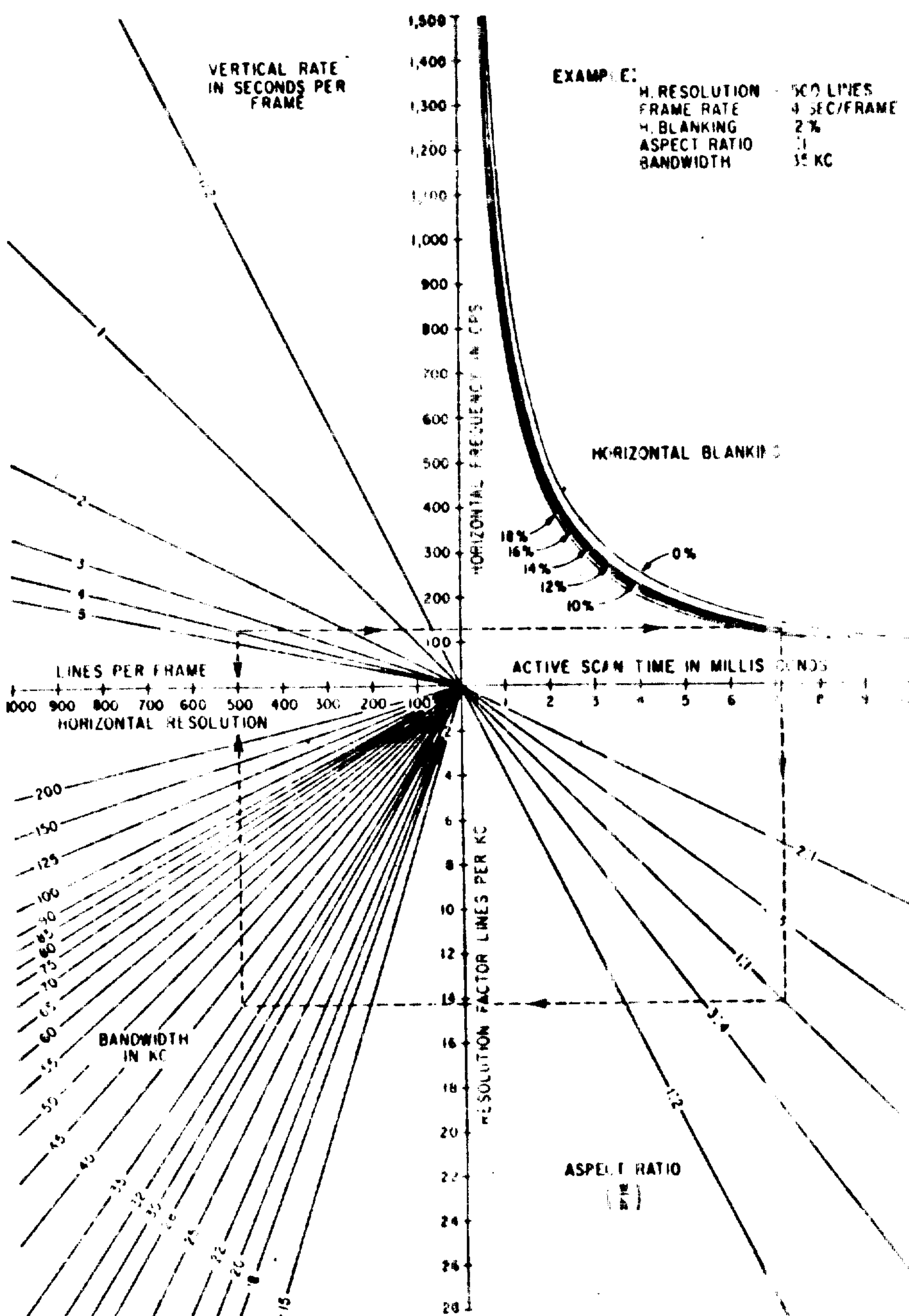
the formula $H_r = 2[(1 - B)/f_s](BW/A)$ relating horizontal resolution to the scanning frequency, horizontal blanking time, video bandwidth and aspect ratio.[4] Here H_r is the horizontal resolution in tv lines, B is the percent horizontal blanking, f_s is the scanning frequency in cps, BW is the bandwidth in cps, 2 is the number of changes per cycle (for black and white resolution lines) and A is the aspect ratio (w/h).

Assume that an f-m transmission link is to be used having an r-f bandwidth of ±10 Kc with a 2:1 deviation ratio as calculated from the signal-path noise characteristic. Since only 5 Kc of video bandwidth is allowable, the designer must critically examine the subject of information to be transmitted. Surveillance of instruments and gages which indicate comparatively slowly may require fairly good resolution but yet the information rate or the number of pictures transmitted per second can be low. On the other hand, rapidly changing events may require moderate resolution (350 tv lines) at a more rapid framing rate (½ fps).[4] The problem of arresting subject motion when using slow framing rates is a separate consideration[5] that can be accommodated by electrical or mechanical shuttering[6] when natural lighting is available or by strobe lighting the subject.

TYPICAL SOLUTIONS—Given the 5-Kc video bandwidth with a subject of cloud formations the designer may choose a frame rate of one picture every 10 seconds. Since the subject orientation and physical makeup may best fit a square format (1:1 aspect ratio), approximately equal horizontal and vertical resolution will be selected. Using the chart, a trial solution will be tested with the three previously determined parameters (bandwidth, frame rate and aspect ratio). For instance, from chart C: select 300 lines per frame at a frame rate of 10 sec and read 30 cps horizontal frequency. Using a 10-percent blanking factor (admittedly on the low side) as a first approximation, proceed to the 1:1-aspect ratio diagonal. Moving from this point to the interception with the 5-Kc bandwidth trace, the chart indicates 300 lines resolution proving that the initial selection was reasonable.

The chart is useful to approximate the system parameters within the confines imposed by the transmission link and the subject to be viewed.

As another example, determine the system parameters for minimum bandwidth when the

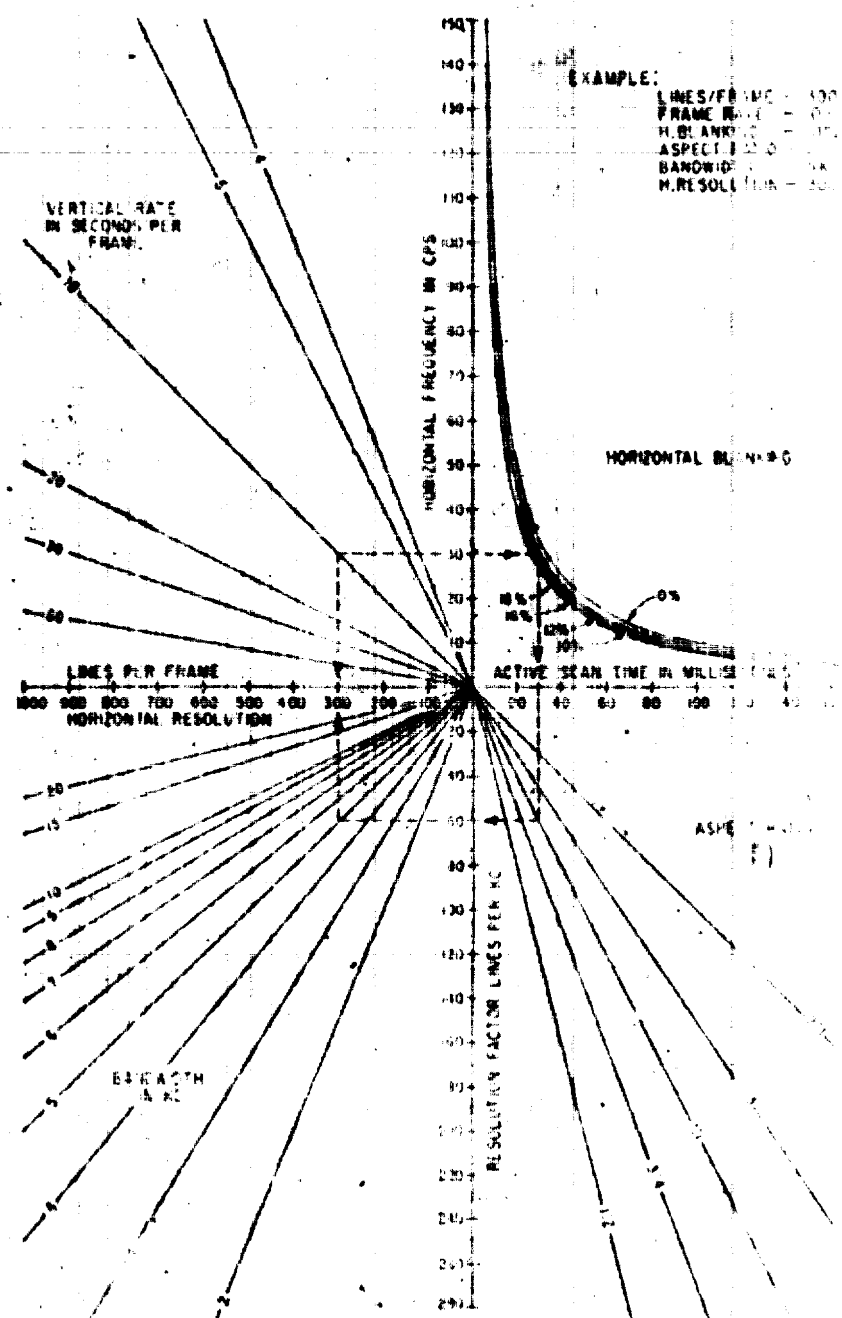


(B)

desired horizontal resolution is 500 lines and the framing rate is 4 sec/frame. Inspection of chart B shows that the bandwidth will have to be greater than 15 Kc to have a vertical resolution of at least 200 lines. Assuming that the vertical resolution is to be close to that of the horizontal, the other conditions for minimum bandwidth are: aspect ratio should be a minimum (although usually not less than 1:1 unless the outline of the subject warrants); and blanking time should be a minimum. While this is governed by circuit design, practical percentages will fall in the same range regardless of the scan rate.

Using a minimum of 12-percent blanking (the circuit designer will probably want more), and an aspect ratio of 1:1, trial plots can be made starting from 500 lines resolution in an attempt to arrive at a desirable horizontal scanning frequency. For instance, for about 35-Kc bandwidth, read 125 cps horizontal and 500 lines per frame. For less bandwidth, a compromise might be made at the expense of vertical resolution. For 400 lines per frame and 100 cps horizontal, the bandwidth is about 28 Kc.

While this article touches superficially on the study of resolution, more comprehensive treatments are to be found in the many references[1-16].



(C)

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